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ALTERNATE REDUCED SIZE ON-SCREEN POINTERS FOR ACCESSING
SELECTABLE ICONS IN HIGH ICON DENSITY REGIONS OF
USER INTERACTIVE DISPLAY INTERFACES

Cross Reference

5　United States Patent Applications:
TEMPORARILY MOVING ADJACENT OR OVERLAPPING ICONS AWAY
FROM SPECIFIC ICONS BEING APPROACHED BY AN ON-SCREEN
POINTER ON USER INTERACTIVE DISPLAY INTERFACES (Attorney
Docket No. AUS9-2001-0345-US1) and DIRECTING USERS'
10　ATTENTION TO SPECIFIC ICONS BEING APPROACHED BY AN ON-
SCREEN POINTER ON USER INTERACTIVE DISPLAY INTERFACES
(Attorney Docket No. AUS9-2001-0336-US1) having the same
inventors and assignee of the present application and
filed concurrently herewith and hereby incorporated by
15　reference.

Technical Field

The present invention relates to user interactive
computer supported display technology and particularly to
such user interactive systems and methods that are user
20　friendly and provide computer users with an interface
environment that is easy to use, even in displays which
are crowded and cluttered with icons.

Background of Related Art

The past decade has been marked by a technological
25　revolution driven by the convergence of the data
processing industry with the consumer electronics
industry. This advance has been even further accelerated
by the extensive consumer and business involvement in the
Internet or World Wide Web (Web) over the past several
30　years. The terms Internet and Web are used

interchangeably throughout this application. As a result of these changes, it seems as if virtually all aspects of human endeavor in the industrialized world require human-computer interfaces. These changes have made computer

5   directed activities accessible to a substantial portion of the industrial world's population, which, up to a few years ago, was computer-illiterate, or, at best, computer indifferent.

In order for the vast computer supported industries

10   and market places to continue to thrive, it will be necessary for increasing numbers of workers and consumers who are limited in computer skills to become involved with computer interfaces.

Despite all of the great changes that have been made

15   in the computer industry, the screen cursor controlled manually by the user still remains the primary human-computer interface. The user still commands the computer primarily through manual pointing devices such as mice, joy sticks and trackballs which control the on-screen

20   cursor movements. It must be noted that the principles involved in such pointing devices were developed over a generation ago when most of the people involved in interfaces to computer were computer professionals who were willing to invest great amounts of time in

25   developing computer skills. It is very possible that had computers originally been the mass consumer, business and industry implements which they are today, user interfaces that were much easier and required less skill to use would have been originally sought and developed.

30   Nonetheless, the manually controlled cursor movement devices are our primary access for cursor control. The present invention is directed to making mouse, trackball

and the like cursor control devices more user friendly
and effective.

Icons in Graphical User Interfaces (GUIs) are, of
course, the primary access through which the user may
5   interactively select substantially all computer functions
and data. Thus, the number of icons that the user has to
contend with in the navigation of his cursor to his
target icon has been greatly increasing. These may be
arranged in many layers of windows. In certain portions
10   of the user's display screen, there may be dense
populations of icons. The icons may overlap or be
stacked one on the other.

In addition, the user's desktop display screens have
been increasing in size to thereby provide the user with
15   the luxury of some room for icon spacing to visually
separate icons. On the other hand, users are extensively
using laptop computers, and palm-type devices including
Personal Digital Assistants (PDAs) and even cell phone
displays to supplement their desktops. Thus, the desktop
20   displays need to be replicated on these smaller screen
devices to thereby make the icons even more closely
spaced. In any event, whether it be on the desktop,
laptop or a smaller screen device, the selection of icons
or like displayed objects and items from crowded screen
25   areas presents a problem.

Summary of the Present Invention

The present invention offers an implementation for
the interactive selection of icons from display screen
areas crowded with a high density of icons. The
30   invention provides a user activated cursor control
device, such as a trackball or mouse, that is movable in
the four orthogonal directions. The control device is

connected to the computer which includes means for
converting the user activated orthogonal movements into
cursor or pointer movements in said four directions. The
key to the present invention is in the setting of a

5   predetermined minimum clearance factor with respect to
the target items or icons being approached which is
required in order that a pointer or cursor of the current
size have sufficient clearance to select an item or icon.
There are means for determining whether a selectable icon

10 being approached by said pointer has this minimum
clearance factor, in combination with means responsive to
a determination that said approached item does not have
said minimum clearance factor for reducing the size of
said pointer to a pointer having a reduced minimum

15 clearance factor that is appropriate for a selection of
the target icon.

In some user interactive display interfaces, the
minimum clearance factor may be determined primarily as a
minimum clearance distance that the target icon must be

20 spaced from all adjacent icons. In other words, the
target or approached icon must be further from its
closest adjacent icon than the minimum clearance distance
required for an icon selection by the particular size
pointer or cursor being used. If not, the cursor is

25 reduced in size to a cursor having such a minimum
clearance distance.

In other user interactive interfaces, a more
comprehensive determination of the minimum clearance
factor may be made that includes not only the distance

30 that the target icon is spaced from adjacent icons but
also the visible dimensions of the target icon. For
example the minimum clearance factor may be defined by:

Minimum Clearance = d + s wherein:

d is the widest visible dimension of the approached icon, and

s is the space between the approached icon and the closest adjacent icon in a continuation of the d

5   dimension line.

Brief Description of the Drawings

The present invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the

10   following drawings, in conjunction with the accompanying specification, in which:

Fig. 1 is a block diagram of a generalized data processing system including a central processing unit that provides the computer controlled interactive display

15   system which may be used in practicing the present invention;

Fig. 2 is a diagrammatic view of a display screen illustrating an example of a cursor movement toward a target icon that is so crowded between adjacent icons

20   that the clearance factor is less than the minimum for the particular cursor;

Fig. 3 is the diagrammatic display view of Fig. 2 but illustrating the substitution of a reduced size cursor having a reduced minimum clearance factor so that

25   the clearance factor with respect to the target icon position now exceeds this reduced clearance factor;

Fig. 4 is a magnified portion of the view of Fig. 2 illustrating the target icon arrangement of Fig. 2 with the full sized cursor;

30   Fig. 5 is a magnified portion of the view of Fig. 3 illustrating the target icon arrangement of Fig. 3 with the reduced sized cursor;

Fig. 6 is a magnified view of a cursor/target icon arrangement wherein the full sized cursor has a minimum clearance factor which is exceeded by the arrangement;

Fig. 7 is a magnified view of a cursor/target icon
5   arrangement wherein the full sized cursor has a minimum clearance factor which is not exceeded by the arrangement;

Fig. 8 is a magnified view of a cursor/target icon arrangement of Fig. 7 wherein a reduced sized cursor has
10   been substituted with a minimum clearance factor which is exceeded by the arrangement;

Fig. 9 is a flowchart of the program steps involved in setting up a process for the substitution of a reduced sized cursor when the cursor/target icon arrangement of
15   the full size cursor fails to exceed the minimum clearance factor;

Fig. 10 is a flowchart of the steps involved in an illustrative run of the process set up in Fig. 9; and

Fig. 11 is a progressive magnified view for stages
20   of a portion of an illustrative display screen in which a group of icons are so closely clustered together that the icons/cursor arrangement initially fails to have minimum clearance, and an icon enlargement sequence follows enabling the user to reach his target icon.

25   <u>Detailed Description of the Preferred Embodiment</u>

Referring to Fig. 1, a typical data processing system is shown that may function as the computer controlled display terminal used in implementing the system of the present invention of providing a reduced
30   sized cursor when the full sized cursor has a minimum clearance factor that is not exceeded by the cursor/target icon arrangement. A central processing

unit (CPU) 10, such as any PC microprocessor in a PC
available from International Business Machines
Corporation (IBM) or Dell Corp., is provided and
interconnected to various other components by system bus

5   12.   An operating system 41 runs on CPU 10, provides
control and is used to coordinate the function of the
various components of Fig. 1.   Operating system 41 may be
one of the commercially available operating systems such
as Microsoft's Windows98$^{(TM)}$ or WindowsNT$^{(TM)}$, as well as

10 the UNIX or IBM's AIX operating systems.   An application
program for providing a reduced sized cursor when the
full sized cursor has a minimum clearance factor that is
not exceeded by the cursor/target icon arrangement to be
subsequently described in detail, runs in conjunction

15 with operating system 41 and provides output calls to the
operating system 41, which in turn implements the various
functions to be performed by the application 40.   A Read
Only Memory (ROM) 16 is connected to CPU 10 via bus 12
and includes the Basic Input/Output System (BIOS) that

20 controls the basic computer functions.   Random Access
Memory (RAM) 14, I/O adapter 18 and communications
adapter 34 are also interconnected to system bus 12.   It
should be noted that software components, including
operating system 41 and application 40, are loaded into

25 RAM 14, which is the computer system's main memory.   I/O
adapter 18 may be a Small Computer System Interface
(SCSI) adapter that communicates with the disk storage
device 20, i.e. a hard drive.   Communications adapter 34
interconnects bus 12 with an outside network enabling the

30 data processing system to communicate with other such
systems over a Local Area Network (LAN) or Wide Area
Network (WAN), which includes, of course, the Internet.
I/O devices are also connected to system bus 12 via user

interface adapter 22 and display adapter 36. Keyboard 24
and mouse 26 are all interconnected to bus 12 through
user interface adapter 22. Mouse 26 operates in a
conventional manner insofar as user movement is

5   concerned. Display adapter 36 includes a frame buffer
39, which is a storage device that holds a representation
of each pixel on the display screen 38. Images may be
stored in frame buffer 39 for display on monitor 38
through various components such as a digital to analog

10   converter (not shown) and the like. By using the
aforementioned mouse or related devices, a user is
capable of inputting information to the system through
the keyboard 24 or mouse 26 and receiving output
information from the system via display 38.

15   With reference to Fig. 2, the display screen 50
shown has a great number of icons 51 (simplified to just
squares for illustration). Actually the number of icons
has also been minimized for this example. It is
understood that there may be icons arranged in patterns

20   of greater or lesser icon density, i.e. greater spacing
between icons. Thus, as the cursor 52 is moved along and
approaches an icon 54 surrounded by adjacent icons 54 and
55, a determination has to be made as to whether the
cursor has a minimum clearance factor, i.e. a cursor 52

25   of the current size will have sufficient clearance to
select icon 54. The process determines whether icon 54
being approached by cursor 52 has this minimum clearance
factor in combination with means responsive to a
determination that said approached item does not have

30   said minimum clearance factor for reducing the size of
said pointer to a pointer having a reduced minimum
clearance factor that is appropriate for a selection of
the target icon. How minimum clearance factors may be

determined will be considered in greater detail in the
examples of Figs. 4 through 8. With respect to Fig. 2,
with the arrangement of target icon 54, adjacent icons 53
and 55 with respect to approaching cursor 52, let us
5   assume that the minimum clearance factor has not been
exceeded. Then, as shown in Fig. 3, reduced size cursor
56 is substituted which has a reduced minimum clearance
factor that is now exceeded by the arrangement shown so
that reduced size cursor 56 has sufficient space to
10   access and select icon 54.

Now, with respect to Figs. 4 through 8, we will give
some examples of how minimum clearance factors may be
determined. In Fig. 4, the minimum clearance factor is
shown as a radius R of halo 58 around the point of cursor
15   52. It may be determined whether the arrangement of the
target icon 54 and its adjacent icons 53 and 55 exceed
this minimum by simply determining whether the distance
between the target icon and its closest adjacent icon
does not exceed R. Then, the minimum clearance factor
20   would merely be a minimum clearance distance between the
target and adjacent icon. Since this does not exceed R,
the cursor is too large and a reduced cursor must be
substituted in order to select the icon.

While minimum clearance distance would certainly be
25   operable in the present invention in determining whether
the target icon is selectable with a full sized cursor,
it is recognized that other factors, such as the widest
visible dimension of the target icon, could be a
determining factor in the calculation of a minimum
30   clearance factor. For example, the following equation
could be used in determining whether the minimum
clearance factor has been exceeded:

Minimum Clearance = d + s wherein:

d is the widest visible dimension of the approached icon, and

s is the space between the approached icon and the closest adjacent icon in a continuation of the d

5   dimension line.

The minimum clearance factor will be calculated in accordance with this equation in the examples of Figs. 4 through 8.

In Fig. 4, s = 0, since adjacent icon 53 abuts

10   target icon 54, thus d + s = d, and d < R. Thus, the minimum clearance factor is not exceeded and the reduced size cursor 56 is substituted, Fig. 5, which has a halo 59 with a radius r. However, d > r, whereby the minimum clearance factor is exceeded and icon 54 may conveniently

15   be selected by using reduced size cursor 56.

In the example of Fig. 6, the space between target icon 61 is relatively distant from adjacent icon 62. Thus, s + the widest dimension d of target cursor 61 far exceeds radius R of cursor halo 63 of cursor 60. Thus,

20   the icon arrangement is sufficiently spaced that the full sized cursor 60 may be used to target icon 61. On the other hand, in Fig. 7, the dimension d of target icon 72 + s, the space from adjacent icon 71, is less than the radius R of cursor 70 halo 73. Thus, full sized cursor

25   70 is too large. As shown in Fig. 8, reduced cursor 75 is substituted wherein with radius r of the cursor halo 76, d + s > r, and reduced size cursor 75 may conveniently be used to make the selection of target icon 72.

30   Now, with reference to Figs. 9 and 10, we will describe a process implemented by the present invention in conjunction with the flowcharts of these figures. Fig. 9 is a flowchart showing the development of a

process according to the present invention for
distinguishing between closely spaced icons in a high
icon density region of a display screen. In a personal
computer set up with a desktop GUI and an operating

5   system, a routine is provided for tracking cursor
movements between points on a display screen, step 90. A
routine is provided for tracking cursor positions on the
display screen, step 91. A routine is set up for
providing a circular halo with a predetermined radius

10   around the cursor point, step 92. Then a routine is set
up, step 93, for determining when an icon being
approached by a cursor comes with the cursor halo. A
process is set up for setting a minimum clearance factor
that will determine whether the target icon has

15   sufficient clearance from adjacent icons to permit a
selection by the present sized cursor; for example, as
set up above, the relationship: $c = d + s > R$, where c =
minimum clearance; d = widest visible dimension of target
icon; s = space from the closest adjacent icon; and R =

20   radius of the halo, step 94. Then, a routine is set up
for substituting a smaller cursor with reduced halo
radius if the clearance factor is below the minimum in
step 94 so that the smaller cursor has a radius r,
whereby $c = d + s > r$, step 95.

25   The running of the process will now be described
with respect to Fig. 10. First, step 100, the cursor is
moved in the direction of an icon that the user wishes to
select. A determination is made with respect to the
moving cursor as to whether there is an icon within the

30   halo surrounding the point of the cursor, step 101. If
No, the movement continues, step 100. If Yes, the
minimum clearance factor for this target icon is
determined by the equation $c = d + s > R$, as described

above, step 102, and a determination is made, step 103,
as to whether there is minimum clearance. If Yes, the
icon selection using the initial cursor is enabled, step
105. If the determination in step 103 is No, there is no

5   minimum clearance present with the original cursor size,
a smaller cursor is substituted, step 104. A further
determination is made as to whether the reduced size
cursor has a halo radius so small that minimum clearance
is present, step 106. If Yes, then the icon selection

10   using the original cursor is enabled, step 105. After
step 105, or if the minimum clearance is still not met by
the reduced size cursor, a No from step 106, then a
determination may conveniently be made here as to whether
the session is over, step 107. If Yes, the session is

15   exited. If No, the flow is returned to step 100 where
the cursor is moved.

In accordance with another aspect of the present
invention, as shown in Fig. 11, where a group of icons
are so closely clustered together that the icons/cursor

20   arrangement initially fails to have minimum clearance, an
icon enlargement sequence may be followed as shown in
steps 1 through 4 enabling the user to reach his target
icon. This is similar in operation to sequential
highlighting sequence described in above-referenced

25   copending application, Attorney Docket No. AUS9-2001-
0336-US1, and the icon exposure sequence described in the
above-referenced copending application, Attorney Docket
No. AUS9-2001-0345-US1. In step 1 of Fig. 11 there is an
a cluster of icons, 113, 114 and 115 being approached by

30   cursor 111 in an arrangement without minimum clearance,
i.e. the cursor does not have enough room to select one
of the clustered icons without encroaching upon the
others. Accordingly, there is a sequence followed in

which each of the cluster of icons 113 through 115 are
enlarged relative to the cursor so that the cursor 111
will have at least minimum clearance to the icon. In
step 2, icon 113 is enlarged, in step 3, icon 114 is
5   enlarged, and in step 4, icon 115 is enlarged. From the
size of the cursor relative to the enlarged icon, it is
obvious that even with the specific equation for
determining clearance, as set forth above, d, the widest
visible dimension of the enlarged target icon will be
10   greater than the radius of halo 116 around pointer 111.
Thus, there is minimum clearance with the enlarged icons.

Also, dependent upon the closeness of the
separation, even with the enlarged icon providing minimum
clearance, there may be arrangements of icons where each
15   icon is only activated, i.e. enabled for selection only
when the icon is enlarged. The sequential icon
enlargement process need not be automatic. A first icon
in the cluster or set may be enlarged first, e.g. the
icon closest to the cursor. The user may then select it
20   by moving his cursor into the enlarged icon, avoiding the
adjacent non-enlarged icons and clicking on one of his
mouse buttons to make the selection. Otherwise, the user
may without moving his cursor step to enlarge the next
icon in the sequence by clicking on the other of his
25   mouse buttons.

One of the implementations of the present invention
is as an application program 40 made up of programming
steps or instructions resident in RAM 14, Fig. 1, during
computer operations. Until required by the computer
30   system, the program instructions may be stored in another
readable medium, e.g. in disk drive 20 or in a removable
memory, such as an optical disk for use in a CD ROM
computer input or in a floppy disk for use in a floppy

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disk drive computer input. Further, the program
instructions may be stored in the memory of another
computer prior to use in the system of the present
invention and transmitted over a LAN or a WAN, such as

5   the Internet, when required by the user of the present
invention. One skilled in the art should appreciate that
the processes controlling the present invention are
capable of being distributed in the form of computer
readable media of a variety of forms.

10   Although certain preferred embodiments have been
shown and described, it will be understood that many
changes and modifications may be made therein without
departing from the scope and intent of the appended
claims.